Fetal transcutaneous carbon dioxide tension - promising experiences

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This report deals with first clinical experiences with continuous measurements of $tcPco_2$ in the human fetus. This technique has only now come into fruition after a long interval between the first report which was made by our Research Group in 1973 (1) about the basic possibility to measure this parameter and the present day.

A total of 8 fetuses have been studied during delivery, in the Department of Obstetrics, University of Zurich. A laboratory designed, or the Dräger prototype $tcPco_2$ electrode was used for fetal scalp $tcPco_2$ measurements. These two electrodes are similar in design and construction. Multichannel monitoring equipment was used to make simultaneous recordings of fetal and maternal $tcPco_2$, maternal Po_2, uterine activity and fetal heart rate. The electrode was sterilized in ethylene oxide (Anprolene R) before calibration in 5% and 10% Co_2. The application of the $tcPco_2$ electrode was performed using the same technique as used for fetal $tcPo_2$ (2).

First observations were related to the level and fluctuations of fetal transcutaneous Pco_2. The uncorrected levels of $tcPco_2$ for all fetuses studied ranged between 42 - 67 mm Hg with a mean of 52 mm Hg. There was a tendency for a slight increase towards the end of the first stage of labour in 5 cases. In one of the recordings during the second stage of labour, a fetal bradycardia of 12 min duration was observed, which was accompanied with an increase of fetal $tcPco_2$ from 52 to 85 mm Hg. Two types of fetal carbon dioxide fluctuations were noted in relation to uterine contractions. Small decreases of fetal $tcPco_2$ started about 1o seconds after the beginning of each contraction and returned to the previous level once the contraction was over. These small decreases in fetal $tcPco_2$ were apparently not related in time nor in amplitude to maternal $tcPco_2$ fluctuations as was deduced from simultaneous maternal $tcPco_2$ recordings. In contrast, in some of the recordings, fetal scalp $tcPo_2$ was seen to increase slightly during contractions. Further studies will show whether the described fluctuations are related to changes in temperature , local perfusion beneath the electrode or physiological changes in the perfusion of the fetal scalp.

First insights into maternal-fetal carbon dioxide relationships have become possible by simultaneous maternal and fetal Pco_2 recordings. It was especially interesting to observe the effect of pethidine given to the mother on maternal respiration and on maternal and fetal $tcPco_2$. As a result of reduced maternal hyperventilation after pain relief and/or central sedation maternal $tcPco_2$ usually increased after pethidine administration. Similar effects on fetal $tcPco_2$ within 40 min of administration of the analgesic were observed. Fig. 1 shows that the increase in maternal carbon

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dioxide of 10 mm Hg was accompanied by a rise of 6 mm Hg in the fetal $tcPco_2$ level.

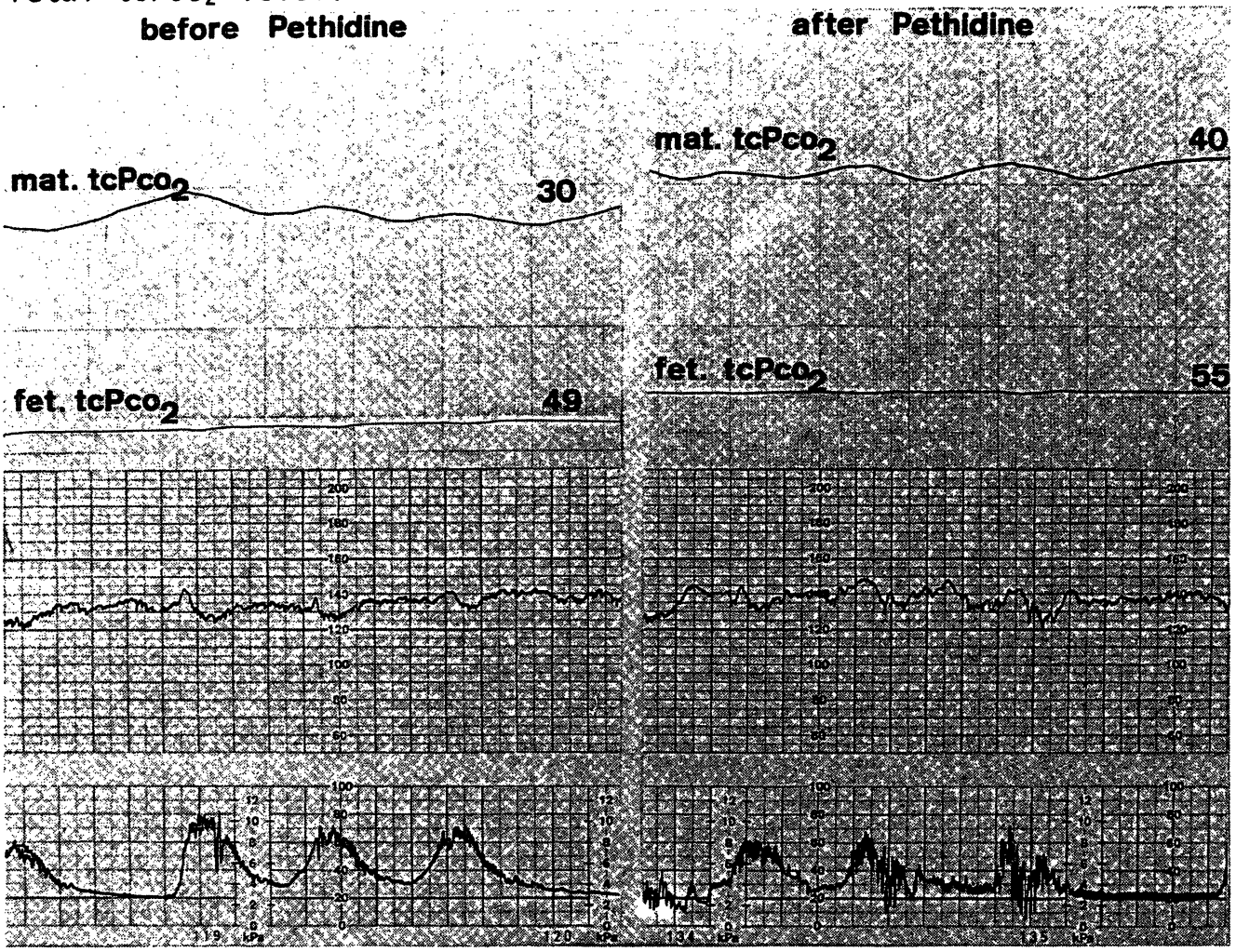

Fig. 1 Parallel increase in maternal and fetal Pco_2 after pethidine

As mentioned at the beginning the transcutaneous technique of carbon dioxide measurement has just recently been developed to the point where it has become possible to apply it clinically. Therefore the limited number of recordings available at this stage of study does not allow conclusions to be made. But it is interesting to note that in each of eight attempts to make a measurement, a successful recording was obtained. This is somewhat better than the experience with fetal $tcPo_2$. Perhaps this improved result is related to the superior diagnostic value of fetal scalp Pco_2 compared to Po_2 which has been obtained from earlier experience with fetal microblood analysis. From our first experience we feel that the fetal $tcPco_2$ technique holds great promise for obtaining valuable data for the further understanding of fetal respiratory physiology and will improve fetal monitoring in clinical practice in the near future.

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